

four or more, the physico-chemical and geological questions; that the latter should have a separate class-list and days of examination, with four written papers of three rows each, and a practical examination; and that the biological examination should have four papers and be in other respects similarly conducted, letting no special marks of distinction be given. Few first-rate candidates would desire to take both these examinations, and if they desire further distinction in particular subjects, original work in research or authorship, is surely the best test; and the University might subsequently give to competent men degrees in science which now it unfairly cannot give; the degree of Doctor of Science should be given to men qualified to be University Readers or Professors in Science.

Mr. Hillhouse, of Trinity, the Assistant Curator of the Cambridge Herbarium, and one of the editors of the *Cambridge Review*, in an article last week, admits that which many promoters of learning might think a sign of unrest and indecision, rather than of real growth, namely, that the regulations issued by the Board of Natural Sciences Studies must be very mutable, and continually need revision. As to the argument for human anatomy as such receiving a prominent place in a tripos, Mr. Hillhouse says it rests on the fallacy that men are likely to study a subject with more interest if it is made a subject of a tripos, than if it is included in the M.B. But, his experience is, the man who will not work for his M.B. will surely not work for his tripos; if anything, he will work better for M.B. than tripos.

The University of London, having for a long time required all candidates for the degree of B.Sc. to pass in elementary mathematics, physics, geology, palæontology, and the other biological sciences, as well as logic, has now reverted to the wiser plan of examining at its 1st B.Sc. in elementary mathematics, physics, inorganic chemistry, and elementary biology, and at the degree examination (for B.Sc.), giving the degree for passing in three out of nine divisions of sciences, so that a biological student may, if he chooses, enter for a very clearly-defined examination in botany, zoology, and physiology. The Cambridge man will then soon prefer the B.Sc. Lond., with the subsequent possibility of a doctorship in science, given for thorough attainment in the special subject of his life-study and teaching, unless biology receives fair play at Cambridge. Why is it that Martin, Hartog, Marshall, and Vines have taken their D.Sc. (Lond.), to mention biologists only? It is surely not that they are devoted to examinations, but that Cambridge was not yet able to give them the distinction in their chosen subjects which they were entitled to demand. Biology, worthy of the name, is still to a very considerable extent proscribed or suspected in Cambridge. In a future age how strange a survival of prejudice this will seem.

G. T. BETTANY

## THE PLANETS OF THE SEASON

### SATURN

WE recently called the attention of our astronomical readers to that noble planet, the captain of our celestial guard, those three that keep the mid-watch of the night in an imposing order that may not return for ages; at distances nearly equal, and in a line not widely deviating from a great circle of the sphere. Saturn, the next in position, may now be the subject of a cursory notice.

The aspect of this most interesting of the planets is at the present time singularly elegant and attractive. The relief, however, is delicate, and the details not conspicuous; but though the presentation may be less adapted for a close scrutiny than that of either the full opening or the evanescent phasis of the ring, its examination will not fail to reward the careful observer.

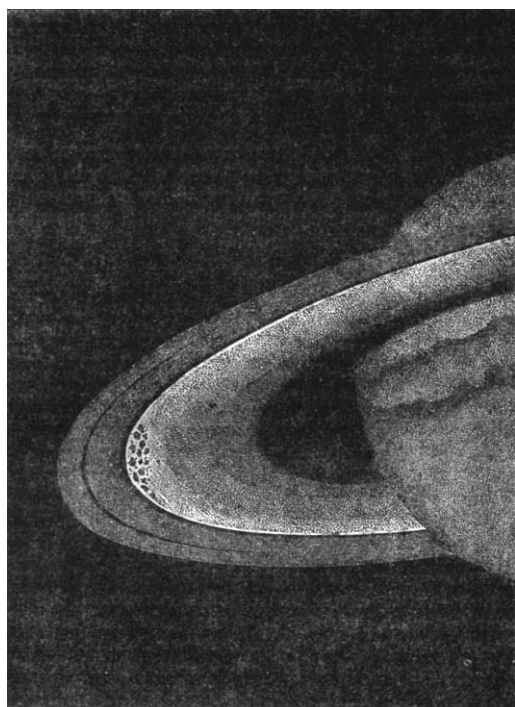
Schröter had a true insight into the pervading character of the universe when he described it as uniform in plan, with an endless variety in detail. Such is evidently the case with the planetary system. We find everywhere arrangements in part closely parallel or even identical with those most familiar to us, in part so rapidly divergent that the connecting analogies are strained, and thin away, as it were, till the bond of union can be traced no longer. Saturn is a complete instance of this. The dependence on the great central ruler, the spherical form, the polar flattening, the rotation on an inclined axis, the accompaniment of an atmosphere—all correspond with our own; while the differences, not only in magnitude, but in density and the force of gravity, are so great that we cannot even guess at the component materials. We endeavoured lately to point out how limited is our knowledge of Jupiter, though in various ways favourably circumstanced for observation; but on Saturn, with the exception of his change of seasons, we should find ourselves still greater strangers; and the terrestrial analogies that aided us so little there would here be of still less service. Every difficulty is magnified by the vast increase of distance and defalcation of light; we can only record what we see, and much of that is neither familiar nor intelligible.

It is easy, however, to perceive a strong general resemblance between these two great globes, not only in gigantic dimensions, want of density, and velocity of rotation, but in various atmospheric characteristics, such as parallelism of direction (sometimes, according to Herschel I., not quite equatorial on Saturn), contrasted colouring, and the occasional formation of bright and obscure patches. And yet in one main feature there is a very marked dissimilarity—the position of their axes. In this one point Saturn, after a decided interruption in the series, reverts to the type of the earth and Mars. And it is scarcely conceivable that the presence or absence of a change of seasons should not be strongly felt in its effects. One result, however, which might on a superficial view have been expected, is absent from Saturn. There is no luminous deposit around the poles, which, on the contrary, are often more dusky than the equatorial regions, and this alone would infer a different atmospheric constitution from our own, even if we left out of sight the consideration that such might well be expected when the subjacent materials are as light as cork, and the whole globe would float high out of water. But for this curious deviation from regular sequence—a kind of deviation so remarkable and so significant in the planetary system—we should have remarked as complete an analogy between Jupiter and Saturn as that which is believed to obtain between the Earth and Mars.

The changes, however, in the atmosphere of Saturn are not usually so conspicuous as those on Jupiter; nor is this to be wondered at, when we consider its inferior brilliancy at a distance measured by hundreds of millions of miles. The equatorial zone is usually represented as of prominent and unvaried brightness, and the dusky belts differ much in depth and arrangement at different times. Luminous and dark patches, though not common, are far from being unknown. The white equatorial spot, resolving itself ultimately into a streak, which was observed by Hall in 1876, though not, as has been asserted, an unprecedented, was a very remarkable instance of the former class, as one perceived by Herschel I., ninety-six years before, had been of the latter. This dusky spot was situated near the limb, where on Jupiter it would presumably have been invisible; yet much could not be inferred from this solitary observation, nor from that of Chacornac on the transit of the largest satellite, which showed a limb more luminous than the centre of the disk. Everything of this kind should be noted, but nothing pressed into the service of a foregone theory.

The flattening of the sphere at the equator, as well as

the poles, announced by Herschel I. as the result of many observations in 1805, has never been very satisfactorily explained. It might have been discarded as an illusion resulting from the crossing of the outlines of the globe and rings, had it not been confirmed by repeated measurement at the time. It is considered to have been subsequently disproved by a repetition of that process in other hands; but it does not appear that the latter measures were taken at a time when the alleged deception existed. An experiment might be tried of placing at a distance from the eye (or better, the telescope, to insure perfectly similar conditions) a transparency copied from Herschel's figure, but with an elliptical, instead of "square-shouldered," outline; but even if, under any varied illumination, the deception should recur, his measures would still have to be accounted for, which do not seem to have been affected by any imperfection in his micrometer.



Part of Saturn's ring as observed by Trouvelot with the 26-inch Washington refractor.

But however this apparent anomaly may be disposed of, we are brought face to face, in the ring-system, with phenomena unexampled, as far as our sight can reach, though there may be thousands of them, and of still stranger thing in the depths of infinity. The minor peculiarities of this complex arrangement are at present not readily traceable in so foreshortened a projection, and some of them would require instruments of great light and power; but the gauzy portion of the slowly-opening ring is already within the reach of moderate apertures. On many accounts these marvellous features deserve an increasing degree of scrutiny as the opportunities for it are becoming more and more favourable; and we may yet gain a further insight into their structure. Still we must not expect too much. Even should the bright rings be, according to the prevalent opinion, a closely-packed mass of satellites, we can hardly suppose it to be "resolvable" with any future increase of optical power. Theory, indeed, pronounces against a solid or even fluid composition; but the confident application of theory may possibly

prove hazardous where materials wholly unknown may be dominated by polar forces of unexplored intensity. It may, indeed, be still an open question whether the aspect of the dusky ring, especially as projected across the ball, can be reconciled with the idea of a thin and scattered stream of satellites, an idea that perhaps would never have occurred to any actual observer, and that seems only a theoretical consequence of the supposed constitution of the other rings. Many questions, in fact, remain open, in this system of wonders; whether its general dimensions, or the proportions of its several parts, are unchangeable; whether minor divisions can always, or ever, be established; whether the gauze ring is distinctly separated from its neighbour; whether its colour is invariable; whether a similar material glazes over, so to speak, the great division of the two bright rings; whether any plausible explanation can ever be attempted of the extraordinary outlines of the shadow of the globe upon the outer ring, consistent with a thinness edgewise almost invisible. There may well be "more things" here "than are dreamt of in our philosophy." And in respect of the general idea of possible changes, it is but fair to bear in mind that our knowledge of this planet is confined to a relatively short period, as compared with his annual revolution. Only some seven Saturnian summers and as many winters have been exercising their influence on that peculiarly delicate and complicated system since the first employment of telescopic investigation—far less time since the commencement of minute scrutiny. And in addition to this the excentricity of the orbit is sufficient to vary the amount of solar radiation at different periods of his year, much more than is the case with our own globe.

It should not be forgotten, too, that the rotation of the ring has hitherto been deduced from theory alone, and ought, if possible, to be determined by observation; though where Herschel I. has failed, and Bond has not succeeded, there may not be a very bright prospect for subsequent observers.

The satellites are interesting in many respects; among others they afford a curious instance of the diversity of detail with unity of idea already alluded to. In our own case the attendant bears so large a proportion to its primary that Earth and Moon have been compared to a double planet. Next, in Mars, we find a ratio of the most opposite description. In Jupiter an intermediate proportion exists between the primary and secondaries, while the latter do not differ in magnitude very widely among themselves. In Saturn we have an extension and combination of the previous systems, not only in number but in character; extreme minuteness in several being found in juxtaposition with considerable bulk in one of the attendants. The striking irregularity of their sequence in point of magnitude is a fresh exemplification of the deviation from uniformity already referred to as so generally, and indeed almost universally, observable in the solar system. It may be noted among the retinue of Jupiter, where the largest is not the outermost of the satellites; but it is still more observable in the more complicated arrangement of the satellites of Saturn. The smallest in a general sense range nearest to the primary, yet the largest is not the most distant; and next in position to him comes the most minute of all. On the same principle it is highly unlikely that the regular progression 1, 2, 4, 8 should express the real number of the satellites attending respectively on the Earth, Mars, Jupiter, and Saturn. More, probably, own the control of the latter, and may be reserved as a triumph for Mr. Common's magnificent 37-inch mirror which the spirited possessor fully deserves.

The well-known fact that the difficulty in detecting objects of this nature diminishes as they become more familiar, is well exemplified in these minute points. Enceladus, once considered as suitable only for great

apertures, has been several times seen by Franks with a 5-inch object-glass; my less acute vision with  $9\frac{1}{2}$  inches of a silvered mirror distinguished it in 1878, not readily, indeed, but quite certainly, in the absence of the primary from the field.

The variable light of the outermost, *Japetus*, in different parts of his orbit, has long been known, and might have been readily explained by a synchronism of rotation and revolution, but for superinduced irregularities similar to those of the satellites of Jupiter, and probably depending upon a similar cause. Schröter detected differences of brightness in some of the others, on opposite sides of the planet; but the subject deserves a fuller investigation.

T. W. WEBB

### NOTES

WE record with deep regret the death of John Allan Broun, F.R.S., on Saturday last, at the age of sixty-two years. Mr. Broun was many years in India, as Director of the Observatory of the Maharajah of Travancore, and has been resident in London for the last six years. We hope next week to give details of Mr. Broun's life and the valuable services he has rendered to meteorology.

WE regret to learn that Prof. A. H. Sayce is compelled to spend the winter in Egypt on account of his health. We trust his sojourn on so congenial a soil will quite re-establish him.

A MARBLE medallion of Father Secchi has been placed in front of the Stilvio Observatory, 2,543 metres above the level of the sea. The observatory owes its establishment to him.

THE Swedish Academy of Sciences has appointed Dr. B. V. Wittrock, the celebrated algologist, to be keeper of the botanical department of the Swedish State Museum, in succession to Prof. N. J. Andersson, who has retired in consequence of the bad state of his health.

THE works for creating an astronomical observatory on the top of Etna were progressing favourably, but have been arrested for some months owing to the state of the weather. The central iron cupola and the telescope would have been placed this year if the operation had not been prevented by the large quantity of snow which fell prematurely on the mountain. This establishment is unrivalled for its position under an admirable sky, and will be placed on an immense natural platform situated at an altitude of 3,000 metres above the sea. The central crater has an elevation of 350 metres, and the observatory has been built at its very foot. An hotel is also being built, where twenty persons can find board during fine weather.

THE Municipal Council of Lyons, after a protracted discussion, has voted a credit for raising a statue to Ampère, who was, with Arago, the inventor of the electro-magnet. Ampère was a Catholic, and the son of a magistrate who had been beheaded at Lyons after the great revolution of 1793. The elder Ampère had written the charge against Challier the *Montagnard*, whose death caused the breaking out of civil war and the shedding of the blood which deluged Lyons during so many months.

THE death is announced of the eminent physicist, Friedrich von Ewald. He died at St. Petersburg on October 16 last, at the age of sixty-six years. He was for many years instructor to the Czarewitch.

FRIENDS and admirers of the late Herr Theodor Heuglin, the well-known African traveller, have erected a monument to his memory in the Prager Cemetery, at Stuttgart; it consists of a large erratic block from Upper Suabia, adorned with the medallion portrait of the deceased. Prof. Kopff, of Baden Baden, was the sculptor of the medallion. The monument was unveiled a few days ago. Thee

THE death is announced of Mr. Serjeant Cox, on Monday, in his seventieth year. Mr. Cox was known as the author of several works in physiological psychology, written mainly from a spiritualistic point of view.

AT Hamburg, the resolution has been passed to erect a new Natural History Museum, for which the sum of 1,000,000 marks (50,000*l.*) will be expended. It appears that through the great marine trade of the city, its rich natural history collections are rapidly increasing year by year. Up to the present not one half of these collections could be properly exhibited to the public for want of space. All this will be changed when the new building is completed.

A CATALOGUE of scientific serials, from 1633 to 1876, has been recently prepared by Mr. Samuel H. Scudder, assistant-librarian at Harvard College Library, and under the auspices of that library, which has met the expense of publication, with the expectation that the demand for the volume will refund the outlay, and with the promise that, if so far remunerated, this shall be the beginning of a series of "works such as may be properly undertaken by a public library, and do not offer inducement for commercial speculation." The catalogue embraces the transactions and bulletins or proceedings of learned societies in the natural, physical, and mathematical sciences of all countries, as well as independent journals. It is the result of a large amount of painstaking labour and should prove an invaluable companion to those engaged in research, or otherwise interested in the progress of science.

FEW local natural history societies can show a better record of work done than the Torrey Botanical Club, the *Bulletin* of which is published monthly or bi-monthly. In addition to records of localities and descriptive articles of local and geographical interest, the pages of this publication not unfrequently contain contributions of sterling value on important points of morphology and physiology. Articles of this character in the numbers which have recently reached us are "Notes on the Relative Age and Dimensions of a Number of Different Trees," by N. L. Britton, and "A Few Notes on the Abnormal Absence of Colour in Plants," by A. Hollick.

It is intended to erect a statue at Hanover in memory of the late eminent technologist, Karmarsch.

THE recent Hungarian earthquakes were coupled with phenomena of a most remarkable nature. The large island in the Danube near Old Moldowa was completely cleft in two by one of the shocks. From the chasm thus formed a gigantic column of water shot forth partly flooding the island. On October 18 the giant fountain suddenly ceased to flow, but numerous funnel-shaped craters had formed from which black sand and clay were ejected. Near Weisskirchen the old ruins of the Castle of Gelubacz have fallen in completely, and in the vicinity several caves were rendered inaccessible. These caves were the breeding places of the dreaded Kolumbacs mosquitos, and if this insect is thus exterminated the earthquake may, with all the damage it did, have yet been of some use. Another smart shock was felt at Temesvar on Friday morning last. A violent earthquake is reported from Iceland. It occurred on September 24 last and is ascribed to volcanic eruptions in the Krisuvik mountains, a locality where eruptions have not been known within the memory of the present generation.

RUDOLF FALB has written from San Francisco to German friends to inform them that a monument in Bolivia much more ancient than the times of the Incas has given him a clue to the origin and development of speech and writing. He is apparently inclined to recur to the Semitic hypothesis.

AT the opening meeting, last week, of the Society of Arts the following prizes were awarded:—The Gold Medal, offered for the best means of saving life at sea, to Messrs. J. and A. W.